Forestry Research West

Forest Service
U.S. Department of Agriculture

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A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture

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In This Issue

Cover

Scientists at the Rocky Mountain Station are working to find better ways to utilize wood resources in the Rockies. Here, lumber is being marked to identify it with the beetle-killed logs from which it was milled. Read more about it on the facing page.

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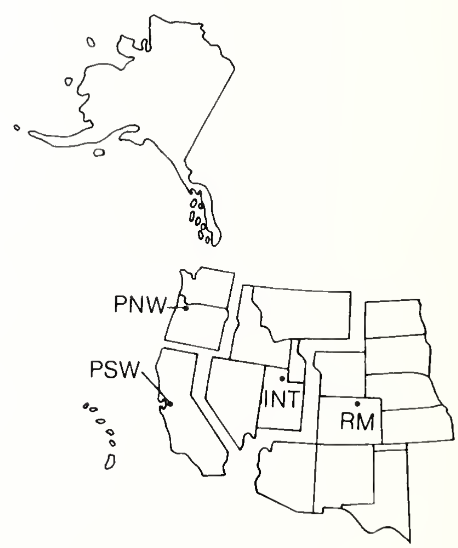


New opportunities for utilization of Rocky Mountain timber

-by Rick Fletcher
Rocky Mountain Station

The Rocky Mountain States—Montana, Idaho, Wyoming, South Dakota, Nevada, Utah, Colorado, New Mexico, and Arizona—contain over 14 percent of the nation's commercial timber resource. However, this region currently provides only 7 percent of the annual U.S. wood requirements. As wood needs grow, along with the population, more complete utilization of the Rocky Mountain timber resource is a practical necessity.

So what are the barriers in those areas where timber utilization is less than the potential? They include low timber volumes per acre, slow growth, steep terrain, inadequate roads, and insufficient economic opportunities to utilize the kinds and amounts of timber that are available.

Scientists at the Rocky Mountain Station are working to help remedy this situation through their forest products research program. Their efforts are aimed at developing planning tools that forest managers, private landowners, and industry can use to find more economically efficient ways to utilize timber that must be harvested to accomplish a wide range of land management objectives.

Black hills particleboard

Harold E. Worth, project leader for the Markets and Uses for Forest Resources unit says, "One of our current concerns is evaluating the technical and economic feasibility of producing particleboard in the Black Hills area of South Dakota and Wyoming. In this area, as in many others, sawmill residues have been increasingly recognized as an environmental problem as well as an economic waste. Residue burning is being phased out. The alternative of dumping these residues into landfills is also becoming unacceptable. If a market can be created for this material, pollution problems will be eased, while creating new jobs for the local economy."

To help solve this problem, the Station's scientists initiated two studies. The first evaluated the technical suitability of six representative types of composition board with varying physical properties. This study showed that particleboard can be manufactured from the area's ponderosa pine mill wastes which will meet or exceed requirements for all standard construction and industrial uses.

Sawmill residues can be an economic and environmental problem.

The second study was aimed at the economics of manufacturing and marketing. This effort included analyses of distribution channels, appropriate technology, specifications and code requirements, transportation channels and costs, and regional competitive factors. The volumes and costs of wood raw materials, along with the industry location, manufacturing process, and other details were also analyzed.

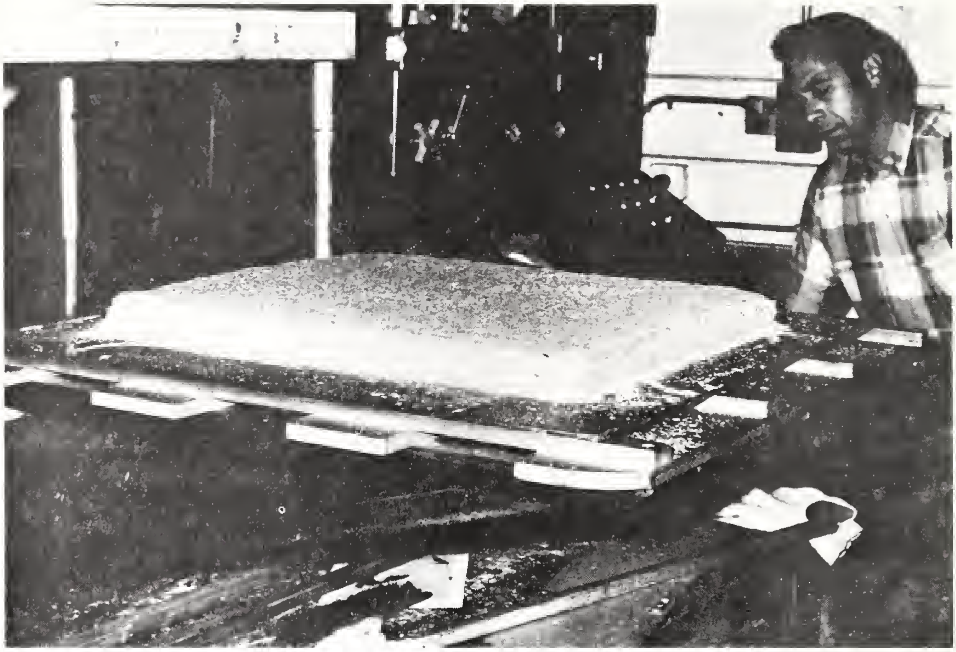
In a nutshell, findings showed that: (1) ponderosa pine, the dominant species in the Black Hills, is a preferred wood for the manufacture of all types of particleboard, (2) the North Central region — Minnesota, Wisconsin, Iowa, etc. — appears to be a prime market for particleboard. The demand in that region is more than double its present production capacity, and (3) the Black Hills, in comparison to other timber producing areas, has lower freight rates to major cities in the North Central region.

The study results also indicate a relatively small particleboard plant (producing up to 33 million square feet per year) could not reduce its costs sufficiently to avoid financial difficulties during weak market periods. However, a larger plant (producing 100 million square feet per year) should realize an attractive financial return under average market conditions and at least break even during poor markets.

Results of this research should encourage industry to consider the possibility of establishing a particleboard manufacturing plant in the Black Hills. They should also be useful to land mangers in maximizing public benefits from the area's timber resource and in assisting industry, government, and economic development groups to improve the local economy.

Beetle-kill study

Rocky Mountain researchers are involved in a cooperative effort with Colorado State University to assess utilization potentials for ponderosa pine and lodgepole pine trees killed by mountain pine beetles in Colorado and Wyoming. For several years, there has been a dramatic increase in the number of trees killed by the beetle in this area. In addition to depreciating scenic beauty, the dead trees present a serious wildfire threat and hamper most land managment activities.



This mat, made of sawmill residue, was pressed into particleboard prior to analyzing the physical properties.

The cost of necessary vegetative treatment, to reduce beetle-caused losses, is usually prohibitive on public and most private land unless the material removed can be utilized for saleable products. With this in mind, Station scientists and university cooperators evaluated utilization potentials for insect-killed and related timber along the Front Range of Colorado. Worth said, "To do this, we first designated timbershed tributary to each of the six most likely processing centers on the basis of harvesting and transportation economics. For these processing centers, we found potential annual harvest far exceeded current industry processing capacity. Production capacity, in turn, was greater than the volume actually being harvested and manufactured into products." For example, the Fort Collins-Loveland timbershed has an estimated annual harvest potential of more than 9.0 million cubic feet of roundwood. This contrasts with a 1977 mill processing capacity estimated at 4.8 million cubic feet and an actual 1977 production of only 2.3 million cubic feet.

To evaluate the effects that special harvesting programs might have, a "goal program" model was developed and applied to each of the processing centers. One formulation of this model incorporated the requirement that ponderosa pine thinnings that could be economically harvested and manufactured into products be given first priority even though other portions of the timber resources would be more profitable for industry. Another formulation of this model had the requirement that top harvesting priority be given to dead ponderosa pine killed within the past five years. Program solutions for each of these situations predicted dollar returns somewhat less than solutions not constrained by special harvesting priorities, but both solutions predicted returns greater than are apparently occurring under present circumstances.

George R. Sampson, market analyst in charge of this work, explains, "For the future, there appear to be prospects for utilizing beetle-kill pine, enhancing opportunities for industry geared to this resource, and improving the overall management of beetle-infested forests in the Rockies. To achieve maximum utilization, public and private timber owners would have to offer to sell as much of the potential harvest as can be processed and marketed by industry. Industry, in turn, needs to know the long-range potentials for local areas and they must be confident that long-term potential harvest on National Forests and other ownerships will be sustained. Industry might then expand timber processing capabilities where economically feasible, and provide the means for more intensive forest management."

The National Forest System is beginning to apply these study results to land management plans. The Roosevelt National Forest in north-central Colorado was the first to use the data in developing their forest plan under the requirements of the National Forest Management Act.

New Mexico study

Worth explained that one of the most unique efforts his project is involved in is helping to develop a rural furniture industry in northern New Mexico.

In this area, inhabitants live primarily in small villages dispersed throughout the mountains and valleys and are burdened by persistently low incomes and high unemployment. Any program designed to alleviate this economic plight should contribute positively to the area's physical and cultural environments to be successful.

A major asset of the area is a high concentration of skilled wood craftsmen, but there are only limited marketing opportunities for their products. Community leaders asked for help in seeking ways to combine these unique human talents with the area's wood resources to improve economic conditions. As a result, the forest products research unit, in cooperation with the University of New Mexico's Bureau of Business and Economic Research, developed a concept for a furniture enterprise that could eventually provide employment and income for more than 200 local families. Worth said, "The approach we followed in tailoring this operational concept to local conditions appears to have much broader applications in economically depressed areas throughout the Southwest.

An initial analysis conducted by the researchers found that there were enough skilled craftsmen to support a wood handcraft enterprise and good general acceptance of the concept in the rural communities it is intended to serve.

A conceptual model and scenario for the prospective enterprise were then developed, cost and revenue estimates derived, and calculations made of the rate of return that could reasonably be expected from the necessary investment. Results showed that the proposed enterprise should be economically feasible and socially desirable to the local people.

Specific measurements are taken on beetle-killed and non-beetle-killed logs as they enter the mill in order to compare product yields and quality.

Utilization studies have helped determine product and yield potential for beetle-killed ponderosa pine.

A typical handcraft furniture shop in northern New Mexico.

Findings from this study have been presented to 11 interested groups, the intent being to gain public support for the concept and to stimulate private implementation of the proposed enterprise. If successful, these efforts would generate additional annual income averaging over $10,000 for the more than 200 families benefiting directly from this industry.

Existing local firms are already using production and technology resulting from the study to benefit their businesses, and the Forest Service's Southwestern Region is using the approach to develop other management programs that will benefit the people of northern New Mexico.

So what does this kind of research mean for the land manager? It identifies economic opportunities for timber harvest that will create healthier tree growing conditons and help preserve other high-priority benefits such as water, recreation, and scenic beauty. It should also lead to greater contributions to the local, and national timber supply. Further, it is expected to enhance relationships with the local people and industry by identifying opportunities that will help them meet their socioeconomic expectations.

Woodcraftsmen in northern New Mexico produce beautiful hand-made furniture. However, better marketing opportunities are needed.

Details on these efforts and other forest products research can be found in the following publications, available from the Rocky Mountain Station. If you would like additional information, contact Harold E. Worth, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect St., Fort Collins, Colorado 80526. Phone (303) 221-4390, FTS-323-1219.

Technical Feasibility of Producing Particleboard from Black Hills Ponderosa Pine, Research paper RM-173-FR19, by Donald C. Markstrom, William F. Lehmann, and J. Dobbin McNatt.

Local Benefits of National Forest Resources in North-Central New Mexico, New Mexico State University, Agricultural Experiment Station Research Report 327, November 1976, by James R. Gray and Burton C. English.

The Feasibility of a Handcrafted Wood Furniture Enterprise in North-Central New Mexico, Reprinted from New Mexico Business, April 1978, by Jerome H. Holmlund, Harold E. Worth, and Lee B. Zink.

Marketing Considerations for Products from Dead Timber, Reprint from the proceedings, symposium: the Dead Softwood Timber Resource, May 1978, Washington State University.

Composition Board from Standing Dead White Pine and Dead Lodgepole Pine, proceedings from the Tenth Washington State University Symposium on Particleboard, March 1976, by Thomas M. Maloney, John W. Talbot, M. D. Strickler, and Martin T. Lentz.

Size and Moisture Content of Pulp Chips from Living and Dead Engelmann Spruce and Subalpine Fir, Research Note RM-334-FR19, by Donald C. Markstrom, Harold E. Worth, and Thomas Garbutt.

Production Opportunities in Laramie, Wyoming, a reprint from U.S. Department of Agriculture, 1978, Structural Flakeboard from Forest Residues: Proceedings of a symposium, USDA Forest Service, General Technical Report WO-5, Washington, D.C., June 6-8, 1978, Kansas City, Missouri.

Let's harness the energy of red alder

-by Dorothy Bergstrom
Pacific Northwest Station

Red alder in this 10-year-old managed plantation have straight boles and average more than 4 inches in diameter and 35 to 40 feet in height.

Red alder has a reputation in the West as a successful—but often unwelcome—competitor of conifers. Forest managers have discouraged alder because it has been more profitable to grow conifers. But the same qualities which make alder a hardy competitor also make it potentially useful. Alder is fast growing, outstripping associated conifers for the first 30 years, and its wood is suitable for many products. In addition, its ability to "fix" nitrogen from the atmosphere makes red alder an important pioneer species, and it is commonly found as one of the first plants to invade clearcuts, flood plains, landslides, and old road beds. Red alder is the only western tree species that adds nitrogen to the soil at the same time it produces usable wood.

In spite of having been discriminated against by foresters for years, alder's pioneering self-sufficiency has enabled it to prosper. Alder covers a large portion of the low-elevation coastal forest area from Alaska to central California, and there is more alder now than when the white man came west. The volume of standing alder sawtimber in Oregon and Washington alone equals the volume of standing hardwood sawtimber of all species in the six northeastern States.

The possibility of harnessing the capabilities of red alder in managed forests has received increasing consideration in recent years, but so far has not been economically attractive. Researchers at the Pacific Northwest Station's Forestry Sciences Laboratory in Olympia, Washington, say this situation is changing, and it may soon be profitable to put alder to work. As demands for wood fiber increase, and costs of chemical fertilizers and energy rise, alder looks more and more like a money tree. The researchers suggest that forest managers begin now to consider alder in their management plans.

Silviculturist Dean DeBell is leader of research at the Olympia laboratory, where most of the Station's current work on alder is being done. He says, "Although most foresters know that alder grows fast and improves soil conditions, they may not be aware that energy that must be invested to grow a given amount of wood is lower for alder than for most other species. Alder also offers forest managers a lot of flexibility because it grows rapidly over a wide range of site conditions. It is suitable for management systems ranging from short coppice (stump sprouting) rotations to sawlog production. It can be managed to supply nitrogen to conifer forests, improve forest soil, rehabilitate disturbed sites, and produce wood."

Although there has been little experience with management of alder in the West, research by Station scientists over the past 30 years and major conferences about the species in 1967 and 1977 have produced information that will help forest managers put alder to work.

Benefits to conifers

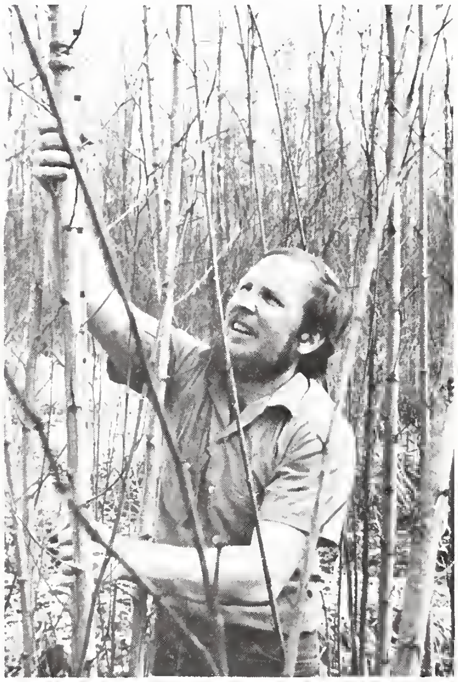
Alder can be used to promote the growth of conifers by growing it in mixed alder-conifer stands or in alternate rotations with conifers. The first documented case of the benefits of alder in the United States came from a mixed plantation of alder and Douglas-fir established as a firebreak on the Wind River Experimental Forest in southern Washington in 1933. The plantation did not receive much attention until 1948, when Soil Scientist Robert Tarrant (now director of the Pacific Northwest Station) happened across it. He noted that the Douglas-fir trees planted with the alder had better color and were larger than trees in adjoining pure Douglas-fir plantations. The mixed plantation contained twice as much wood fiber and had higher soil nitrogen levels than the pure Douglas-fir plantation.

Measurements taken on the Wind River plantation in 1977 showed that the ratio of total wood volume on the mixed plots to the pure Douglas-fir plots was still about two to one. The mixed stands averaged about 3,100 cubic feet of Douglas-fir per acre plus 2,500 cubic feet of alder. Douglas-fir volume in the pure stand was about 2,900 cubic feet per acre.

Nutrient benefits

Alder changes atmospheric nitrogen into a form that can be used by the alder itself and subsequently by other plants. It does this in symbiotic association with soil bacteria or actinomycetes. These bacteria enter alder roots and form nodules. By processes not yet completely understood, the bacteria in the nodules turn nitrogen from air in the soil into nitrogen compounds. This nitrogen moves up into the tree and is incorporated into plant parts. It is later released gradually into the soil when rain washes over alder leaves, when alder leaves fall and decay, or when fallen trees or root systems die and decompose. Some nitrogen may also be released directly from living roots.

Lack of nitrogen is probably the most common nutrient limitation to good growth for both plants and animals. Although it makes up almost 80 percent of the earth's atmosphere, elemental nitrogen is useless to most organisms until it has been "fixed" or combined with other elements such as hydrogen and oxygen. Nitrogen fixation is done industrially through manufacture of chemical fertilizers, a process that normally utilizes energy from fossil fuels. In nature, nitrogen is fixed by certain bacteria and algae—some in a free-living state and others that exist in association with plants such as alder.



Height of 2-year-old sprouts of red alder and black cottonwood is measured before cutting.

The amount of nitrogen produced by alder depends on a number of factors. Estimates of annual nitrogen additions to the forest floor and mineral soil range from 40 to more than 300 pounds per acre. Even on the best Douglas-fir sites where nitrogen levels were already high, researchers have measured annual accretions of 45 to 60 pounds per acre produced by alder.

Ways to add nitrogen compared

Soil Scientist Richard Miller of the Olympia laboratory has compared the costs and uncertainties involved in adding nutrients to forest soils by using red alder and by applying synthetic nitrogen fertilizers. He points out that the number of red alder to use in mixed stands is critical to any economic comparison. Because each red alder replaces at least one Douglas-fir, cost comparisons must involve the relative stumpage returns from the two species as well as the cost of commercial fertilizers.

DeBell and two colleagues from the University of Washington recently estimated the costs and benefits of growing alder in alternate rotations with Douglas-fir. They compared six management options:

1. Grow Douglas-fir alone, thin commercially for sawlogs at 9 inches diameter and again 10 years later, clearcut at age 45.

2. Same as option 1 except add 200 pounds of nitrogen as commercial area fertilizer per acre immediately after each thinning.

3. Grow alder alone for 13 years, clearcut for pulpwood, plant Douglas-fir, then follow option 1.

4. Seed with alder, kill alder with herbicides at age 8, plant Douglas-fir, then follow option 1.

5. Grow alder for 32 years, thin for pulpwood at age 11, clearcut for sawlogs at age 32, plant Douglas-fir, then follow option 1.

6. Same as option 5, except grow to rotations of Douglas-fir before each alder rotation.

The researchers concluded that all regimes were profitable and crop rotation of the two species showed sufficient promise to merit further testing. Management regimes using red alder were not as profitable as systems involving Douglas-fir alone. However, profitability rankings will shift if future costs and prices vary from those assumed for the study. Although a perpetual series of these rotations was assumed, it is unlikely that the yields assumed for Option 1 could be produced indefinitely without the addition of nitrogen.

Soil benefits

In addition to providing nutrients, alder enhances other soil conditions important for growing conifers. Alder leaves decay rapidly on the ground and become incorporated in the upper soil layer, providing organic matter and lowering bulk density. This improves the ability of the soil to absorb and retain moisture and nutrients and provides better conditions for root growth. Laboratory studies indicate that alder produces compounds which may stimulate the growth of some soil organisms and suppress others, including pathogens of conifer roots. For example, alder is resistant to the root rot ***Phellinus weirii,*** which is an increasing problem in conifer forests. The disease organisms remain in stumps and root systems in the ground after timber harvest and infect the next generation of trees. Growing alder instead of susceptible conifers on a site with ***Phellinus*** problems will tend to eliminate the disease.

Biomass plantations

In 1973, Crown Zellerbach, a timber products company, began a trial of coppice management to produce maximum fiber on an island in the Columbia River in southern Washington. They planted red alder and black cottonwood (another fast growing species) in both pure and mixed species plots. DeBell and M. A. Radwan, plant physiologist at the Olympia laboratory, have used these plots to study tree growth and nitrogen accumulation under different stand conditions. Harvests in 1977 provided researchers with an opportunity to measure the effects of alder. Fiber yield from mixed plantings was substantially higher than from the pure cultures of both species. Mean annual yield from the mixed plantation was 4.4 oven-dried tons per acre. Yields from the pure plantations were less than 3 tons per acre.

Nitrogen concentrations in cottonwood twigs were used as one measure of the fertilization effects of alder. Cottonwood twigs from the mixed plantation contained significantly more nitrogen (1.3 percent) than twigs from the pure cottonwood plantation (1.1 percent). Alder twigs in both pure and mixed plots had higher concentrations (1.5 percent).

Nitrogen in the soil was also measured. After only 4 years, the soil under the pure alder contained 23 percent more nitrogen than soil under pure cottonwood. Soil under the mixed plantation had 9 percent more nitrogen than soil in the pure cottonwood plantation.

Findings from this study indicate that coppice management of alder is biologically feasible and that mixtures of alder with cottonwood can produce high yields of biomass for fiber products or energy conversion without application of synthetic nitrogen fertilizers. Perhaps inclusion of alder in mixtures with other hardwood species in other forest regions would produce similar benefits.

Following the third harvest in March 1979, the Washington plots began their fourth rotation on the same root systems. Their location under a powerline suggests a logical utilization for a type of space not suitable for growing conifer forests on long rotations.

Stabilizing disturbed land

The land-healing function of alder can be utilized as the first stage in the rehabilitation of disturbed areas, much as other nitrogen-fixing species are used to reclaim mine spoils in the United States and Europe. A Washington company now uses alder to rehabilitate coal mine spoils and plans to plant half a million alder seedlings in the next 10 years.

The crooked, leaning stems of unmanaged alder often produce low volumes of merchantable wood per acre.

Cutting sprouts of red alder and black cottonwood.

Wood production

So far there has been little positive management of alder for wood products. Although alder produces wood that compares unfavorably with that of conifers for structural uses, it is preferred for furniture and certain products made from pulp. In unmanaged stands, however, per-acre yields of merchantable alder wood are often low, and many stems are of poor quality. Alder frequently grows on moist sites and on terrain that is difficult to log. In addition, the wood decays readily after cutting and must be handled quickly and properly.

Another reason alder has not been managed for its timber is a supply-demand stalemate. Because there has been no steady demand for alder from the small and struggling western hardwoods industry, there has been no economic incentive for forest managers to provide consistent quality alder on a reliable delivery schedule. And, lacking a reliable supply of alder, manufacturers have not been able to enlarge their operations and expand the demand for alder.

However, the wood of alder is well suited for many products. It is red-orange immediately after cutting but soon fades to a uniform light tan. It is one of the most easily stained and finished woods in the world. Its fine, even texture and moderate density have made it popular for furniture, paneling, reconstituted board products, and paper.

Research Forester Constance Harrington of the Olympia laboratory has found that the density of alder wood does not change with age or vary much with growth rates or geographic location. She says, "This kind of uniformity is an asset to the wood products industry. A number of wood and fiber products we make from conifers now probably could be made just as well from alder or a combination of alder and conifer wood." The fiber industry, for example, makes extensive use of residues from mills which manufacture solid wood products from conifers. These residues account for more than 70 percent of the wood needs of some western pulp and paper mills. When the capacity of pulp mills expands beyond the supply of conifer residue material, mills may find that red alder offers a promising source of additional fiber.

Trends toward profitability

Managing and utilizing alder will become increasingly attractive if current trends continue. These trends include: increasing demand for wood fiber, higher costs for energy, depletion of soil nitrogen as conifers are grown on successive, short rotations and utilization becomes more intensive, increasing costs of chemical fertilizers, increasing efficiency of technology and equipment suitable for harvesting small trees, better acceptance and use of alder in furniture and other wood and fiber products, and increased use of wood for energy production.

Another factor likely to have an impact on alder management is the increasing restrictions on the use of herbicides for weed control in conifer plantations. The elimination of alder may become much more difficult and costly. Faced with such problems, forest managers may find that alder management is a viable, perhaps necessary, alternative solution.

Two-year-old stump sprouts are harvested in March 1979 in the third cutting from coppice plantations of red alder and black cottonwood.

Research continues

Research will continue to produce information to help managers make decisions about managing alder. Among studies under way or planned at the Pacific Northwest Station are those that will investigate:

- genetic variation of alder and how this may be manipulated
- influence of alder on soil chemical properties other than nitrogen
- number of alder needed to supply nitrogen to conifers in mixed plantings
- site requirements of alder
- effects of stump age and various cutting methods on alder sprouting
- effects of alder in reducing ***Phellinus weirii*** root rot from diseased sites
- the role of mycorrhizae (fungal symbionts) in alder establishment, growth, and nitrogen fixation

Available publications

Many publications about alder research have been written by Station scientists since Tarrant's pioneering work in the late 1940s. ***Biology of Alder,*** the Proceedings of the 1967 symposium has been reprinted and is again available. The report of the 1977 symposium, ***Utilization and Management of Alder,*** is being reprinted and will be for sale by the Government Printing Office. Several new publications are scheduled for 1979. These include reports from a symposium on the use of symbiotic nitrogen fixation in forest management and an annotated bibliography of published references on alder.

Managers who want help in making decisions about alder can write to the Pacific Northwest Station to request these and related publications. Scientists at the Forestry Sciences Laboratory, 3625-93rd Avenue, S.W., Olympia, Washington 98502 (telephone 206/753-9470, FTS 434-9470), are interested in hearing from managers who are considering alder management programs.

Recently harvested coppice plantations will begin growing the fourth crop of sprouts from the same stumps.

California researchers develop true fir management guidelines

-by Marcia Wood
Pacific Southwest Station

New recommendations on how to solve some of the major problems in managing California red fir and white fir are being developed by researchers at the Pacific Southwest Station. In studies ranging from how to raise nursery seedlings successfully to how to prevent the spread of the parasite dwarf mistletoe in young stands of true fir, researchers are giving foresters practical guidelines for growing healthy, productive fir forests. Results of their research should be applicable to the true fir zone in California.

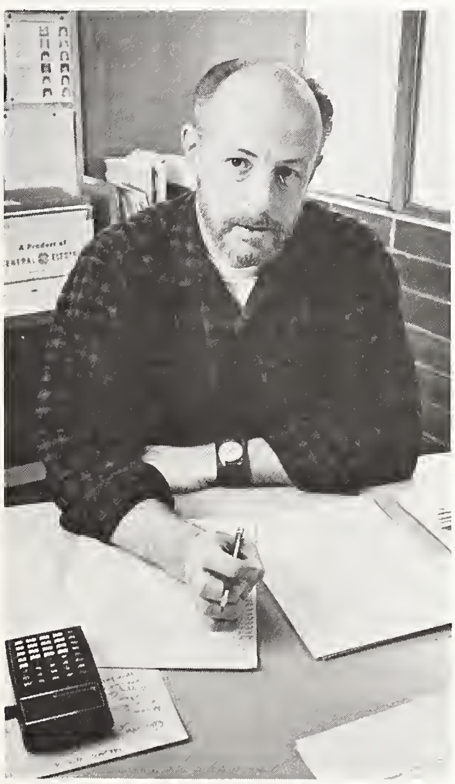
Specialists from a variety of disciplines—forestry, plant physiology, plant pathology, forest entomology, and others—are working together on the true fir studies. All have had the backing of the California National Forests: researchers have participated in problem-solving task forces with the National Forests, have been allowed to use National Forest nursery facilities for their studies, and have had permission to set up study plots on National Forests for experiments with outplanting, thinning, fertilization, and stocking. As frequent speakers at workshops for National Forest, State, and industrial foresters, the scientists have shared their findings with the people who are in a position to put the research results into use.

Plant physiologist James L. Jenkinson has worked with a National Forest group known as the True Fir Task Force to improve the field survival rate of nursery-grown true fir. In scrutinizing each of the procedures used to raise and plant seedlings, the group uncovered many problems and came up with several recommendations that already have improved seedling survival. One key finding was Jenkinson's recommendation for lifting and cold storage. He suggested that true fir seedlings be lifted from the nursery in either December or January, and put in cold storage until spring snowmelts opened high-elevation sites for planting. "Fir seedlings are generally in their deepest dormancy during this period," he explains. "Their root growth capacity, or their ability to grow new roots, can be preserved until spring outplanting by lifting and storing in mid-winter." Previously, seedlings were lifted in the spring. The subsequent outplantings often failed. With Jenkinson's approach, survival has been better than 80 percent—a level the Forest Service's Pacific Southwest Region (which encompasses the National Forests in California) hopes to achieve in its planting programs. Their goals are ambitious—Mitch Knight of the Region's Timber Management Staff says the Region expects 8 million or more true fir seedlings will be needed annually by the late 1980's. Jenkinson's current tests of seedlings from selected geographic locations will show if lifting dates and storage schedules need to be further refined.

California red fir and white fir provide one-fourth of the State's volume of merchantable timber.

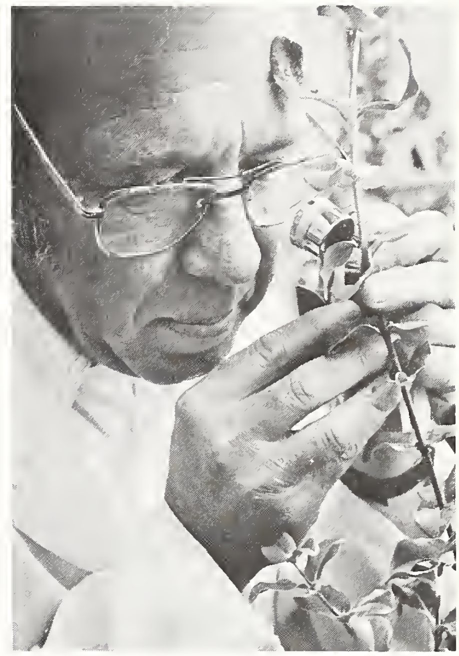
The Task Force has also worked with Robert V. Bega, research plant pathologist with the Experiment Station, to combat root diseases in true fir nursery stock. Bega recommends nursery beds be fumigated with a mixture of 60 percent methyl bromide and 40 percent chloropicrin, applied at the rate of 420 pounds per acre. Where his procedure has been followed, root infections have gone from levels of as high as 80 percent to almost zero.

Bega is now studying mycorrhizal-forming fungi—organisms that form a mutually beneficial relationship with tree roots. His intent is to find out if inoculating nursery beds with these fungi will boost the growth of true fir seedlings and will protect them from root rots. The seedlings he is using will be outplanted after 2 years in the nursery and will be monitored for the next 3 to 5 years after that.



Researcher James L. Jenkinson has improved techniques for raising nursery seedlings of true fir.

Colleague Robert F. Scharpf, also a research plant pathologist, is working with California National Forests in a large-scale demonstration of how thinning may control dwarf mistletoe in true fir stands. Representative stands throughout the southern Cascades and central Sierra Nevada will be thinned to the levels prescribed by silviculturists—regardless of the prevalence of mistletoe. This approach may be an alternative to clearcutting of infested stands. It is based on Scharpf's findings that individual, mistletoe-infected true fir saplings and poles, when released by logging, often outgrow the upward spread of mistletoe. He believes the same response may occur in stands if young trees with good live crown ratios are left in the stand. In the study, sapling and pole-sized trees will be measured before thinning and 5 and 10 years following thinning. He intends to piggy-back the thinning project with two other studies. In one, he will look at the dynamics of the mistletoe populations in thinned stands. In the other, he will investigate the occurrence of ***Cytospora abietis***, a destructive fungus that often appears in mistletoe-infested forests.



Robert V. Bega was technical coordinator of a new field guide to forest diseases.

Research entomologist George T. Ferrell has developed a new "risk rating system" for determining the mathematical probability that a tree will succumb to attack by insects, disease, or other natural causes in the next 5 years. The system is based on his statistical analysis of the characteristics of more than 3,000 living or recently killed true fir. The system currently applies to mature true fir growing in uneven-aged, predominantly old-growth stands in northern California. Ferrell plans similar systems for young-growth fir there, and for both young-growth and old-growth in the central and southern Sierra Nevada.

Research Forester George T. Ferrell has developed a new "risk rating system" for true fir.

Redding studies

At the Experiment Station's silviculture unit in Redding, California, researchers working under the direction of Unit Leader Douglass F. Roy are also studying true fir. Plant physiologist Robert J. Laacke is developing a way for managers to predict whether a proposed management treatment will be successful on their sites. He plans to develop an "environmental classification system," which he describes as "a practical system based upon the critical environmental factors in different latitudes of the true fir zone." When completed, the system should be such that stands falling within the same grouping in the system can be expected to exhibit similar response to management treatments.

Laacke is also studying how stands respond to release. Much of the commercial true fir forest in California is composed of dense, young stands, or stands with mature and overmature overstories and sapling and pole-sized understories. His interest is to find out how understory trees of various age, size, and condition classes respond to release. He is also planning to provide information on both the economic and biologic costs of various stand treatments.

Research forester William W. Oliver's work includes experiments to find the best thinning regimes for sapling and young sawtimber stands of true fir. In the sapling work, plots are being thinned to 5 different levels, allowing from 4 to 18 feet of space between trees. Diameter growth is being measured each year. In related work with saplings, he is attempting to determine their response to release. He is using a selection of some 200 trees, ranging from badly suppressed individuals ("scrawny whips with tuffy little crowns") to others that have been fairly unrestricted in their growth. He will monitor their diameter, height, and crown growth during the 8 years following release. He reports that, so far, "Trees with a live crown ratio of 40 percent at the time of release are responding well."

As with the sapling studies, Oliver's concern with the sawtimber stands is to see how trees respond to different levels of thinning. He contends, "Although there is a lot of young true fir sawtimber around, and although much of it is being commercially thinned, there is very little information available on what might be the proper levels for thinning." In this 10-year study, he is thinning to levels of from 140 to 310 square feet of basal area per acre in stands that are 80 years of age. Trees will be measured before treatment and 5 and 10 years after thinning. He is also keeping track of regeneration within these plots, and hopes to define the relationship between thinning intensity and survival and growth of seedlings.

Research forester Robert F. Powers is looking at stand response to applications of 200 to 400 pounds of nitrogen fertilizer per acre. Growth measurements will be taken before applications and 5 and 10 years later. This comprehensive study will include sites with soil types common to the true fir zone, and will also encompass different cutting systems, thinning regimes, site classes, age classes, and topographic conditions. In other work, he is continuing to monitor long-term effects that hot slash fires may have on the nutrient content of forest soils. His northern California study site has not recovered from the significant loss of soil nitrogen that took place after an extremely hot slash fire some 15 years ago. "High-elevation forests stand to lose a lot of fertility in a very hot slash fire," he says. "Cold temperatures in these stands mean that soil nutrients are decomposed very slowly; those that are tied up in the soil may be destroyed by fire. In the warmer, low-elevation forests, this isn't so much of a problem."

Research forester Charles P. Weatherspoon plans to study the effects slash treatments may have on released true fir understories. "We need to learn to what extent residues can be treated without unacceptable damage to the understory," he explains. He hopes to also study winter logging and slash disposal. He explains, "In winter, an understory that is 2 to 3 feet high and buried by 4 to 5 feet of snow may be less susceptible to damage than at any other time of the year. Over-the-snow harvesting has worked in other parts of the country; it may work here."

Forestry Research West readers who would like to know more about the work these scientists are doing are invited to contact them by phone or mail. The Berkeley scientists—Jenkinson, Bega, Scharpf, and Ferrell—may be reached through the reception desk, (415) 486-3382 (on FTS: 449-3382) or by mail at P.O. Box 245, Berkeley, California 94701. The main phone number for the Redding group (Laacke, Oliver, Powers, and Weatherspoon) is (916) 246-5455. Their mailing address is 2400 Washington Avenue, Redding, California 96001.

One study will determine the amount of damage sustained by seedlings when shelterwood trees are removed.

Publications

Guide to conifer diseases issued

Diseases of Pacific Coast Conifers is a new field guide to identifying tree diseases. The 206-page handbook gives keys for diagnosing diseases, and short descriptions of the main characteristics of each. Needle and root diseases, rusts, mistletoes, and trunk, butt, and root rots, along with galls, canker, and dieback diseases, are each described and illustrated with color and black-and-white photographs. Abiotic disease conditions such as drought, frost, lightning strikes, mineral deficiencies, air pollution, and others, are also discussed.

Robert V. Bega of the Pacific Southwest Station's Forest Disease Unit in Berkeley, California, was technical coordinator for the publication. Station plant pathologists Robert F. Scharpf and Paul R. Miller, along with former PSW scientist Richard S. Smith, each contributed chapters.

Copies of the publication are available, while the supply lasts, from the Pacific Southwest Station. Request Agriculture Handbook No. 521. After that, copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, for $3.75 each. Request stock number 001-000-03727-7.

Promising new grazing system developed

Year-round grazing of livestock ranges in warmer climates is a common practice. However, in the Southwest, where herbage and rainfall are nominal compared to other areas of the U.S., ranges are often fragile and may require special management to maintain optimum forage yields.

S. Clark Martin, range scientist with the Rocky Mountain Station, has worked on improving management techniques for Southwest semidesert ranges for over 20 years. One of his accomplishments is the Santa Rita Grazing System — a 1-year, 3-pasture, 3-year rotation geared to the growth habits of perennial grasses on semidesert ranges in the Southwest. The system is named for the Santa Rita Experimental Range, south of Tucson, Arizona, where much of the research was done.

The grazing system involves: rest 12 months (November-October), graze 4 months (November-February), rest 12 months (March-February), then graze 8 months (March-October) to complete the cycle. Each pasture is rested during both spring and summer growth periods 2 out of 3 years, but each year's forage is utilized. A full year of rest before spring grazing provides old herbage that protects early growth from repeated close grazing. Benefits are greatest where animals congregate, as around water.

Details on the Santa Rita Grazing System have been published in ***Proceedings of the First International Rangeland Congress - 1978.*** Copies of the reprint "The Santa Rita Grazing System", by S. Clark Martin, are available from the Rocky Mountain Station.

Simple field method

Field workers on administrative and research projects often need a simple but reasonably accurate method to estimate intensity of sunlight under forest canopies. Such a method is available, and is described in ***Estimating Light Intensity Beneath Coniferous Forest Canopies: Simple Field Method,*** INT-RN-250, FR19.

The method consists of two processes. First, ocular observations of light intensity are made at regular intervals throughout a study area. These observations are recorded as "full sun" or "shade" intensities, and the proportion of each is identified. The average light intensity is then computed by substituting the proportions into a simple formula.

The procedure is based on the observed fact that crowns of coniferous trees exert little filtering effect on the passage of light. Most sun rays either penetrate openings in the canopy unimpeded or are almost entirely obstructed by foliage.

The method was developed by Charles A. Wellner, an Assistant Director of the Intermountain Station before he retired in 1973. He currently serves as a volunteer at the Station's Forestry Sciences Laboratory, Moscow, Idaho.

For details on the method, write to the Intermountain Station for a copy of the publication.

Expectations from fertilizing Douglas-fir

A soil scientist and an economist from the Pacific Northwest Station offer information to forest managers pondering decisions about the use of nitrogen fertilizers in coastal Douglas-fir forests. Since the mid-1960s, fertilization has joined planting and thinning as a management tool for increasing wood production. Fertilization can be reliable and profitable, the researchers say.

In general, managers can reasonably expect from 200 to 800 additional cubic feet of stem wood per acre from one fertilizing treatment of commercial Douglas-fir forests. Gains generally peak between the third and fifth years and gradually decline to zero within 10 to 15 years. Trials indicate that gains from 200 pounds of nitrogen per acre will be greater on sites III and IV than on better sites. Additional information about current practices and discussions of the biological effects of nitrogen fertilization, environmental considerations, and energy trade-offs are included in the first half of the two-part report.

Whether fertilization will pay depends on several economic factors, including initial costs, interest charges, volume gained, and stumpage prices. An explanation of how these factors operate and work sheets for figuring the break-even volume or stumpage price are included in the second section of the report. In general, it will be more profitable to fertilize stands to be harvested within 10 years of treatment than those to be grown longer, to fertilize larger trees rather than smaller trees on sites of equal productivity, and to fertilize trees growing on poorer sites in preference to trees of equal size growing on more productive sites.

Copies of ***Fertilizing Douglas-fir Forests*** by Richard E. Miller and Roger D. Fight (General Technical Report PNW-83) are available from the Pacific Northwest Station.

Material in the publication is also available in a two-part slide-tape presentation by the same title. Each part is 28 minutes long. The set is available from the Forestry Media Center, Oregon State University, Corvallis, Oregon 97331. Rental cost is $15 and purchase cost is $100 for both slide tapes.

Wood Chemistry

Laboratory analyses indicate there are no chemical barriers to using dead wood of lodgepole pine and western white pine for the same products derived from green wood of the two species. The analyses are the result of a cooperative study of the Intermountain Station and the Wood Chemistry Laboratory, University of Montana, Missoula.

The Intermountain Station has published findings of the study in ***Some Chemical Characteristics of Green and Dead Lodgepole Pine and Western White Pine,*** INT-RN-256-FR19. Authors are Peter J. Lieu, former research associate at the Wood Chemistry Laboratory; Rick G. Kelsey, research associate in the Laboratory; and Fred Shafizadeh, professor of chemistry and Director of the Laboratory.

The study was conducted to explore the expressed concern that fundamental chemical changes may occur in dead wood—especially wood that has been dead for many years. The changes could influence the wood's suitability for uses that involve chemical reactions, such as the manufacture of chip and fiber boards, where adhesive formation and bond strength might be affected. The changes could also affect uses in which products are chemically treated with preservatives, finishes, or other substances.

The "chemical characteristics" study is part of the Intermountain Station's effort to find ways to use one of the largest underutilized wood resources in the Rocky Mountains—dead timber.

Copies of the report are available from the Intermountain Station.

Large logs shape streams

Logs and other large woody debris play an important role in the physical and biological character of small streams in Pacific Northwest forests. By forming pools separated by short waterfalls, logs help slow down stream velocity and stabilize streambeds and streambanks. The result is controlled storage and release of water and sediment and the creation of habitat which allows aquatic organisms to perform functions essential to nutrient cycling and productivity in the stream ecosystem. Individual logs may remain in place for more than a hundred years.

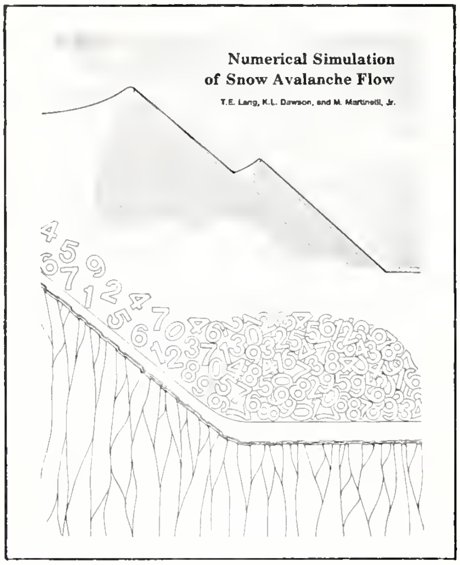
The stream processes and their importance are discussed in *Physical consequences of large organic debris in Pacific Northwest streams,* General Technical Report PNW-69, by Frederick J. Swanson and George W Lienkaemper. The authors suggest that foresters should be aware of the effects of management activities on natural stream processes. They recommend providing maximum options for good stream management by: (1) leaving natural debris in channels and introducing a minimum of additional debris, (2) leaving buffer strips along streams to minimize alterations to streams and provide a source of future natural debris, and (3) improving the layout of cutting units and roads to minimize movement of soil and debris from hillsides.

Copies are available from the Pacific Northwest Station.

Avalanche series out

Many homes, lodges, and other structures are now being built in steep, snow-covered areas of the western U.S. While the number of avalanches has not increased, the hazard to people and property has, and figures on injuries, deaths, and property damage due to avalanches substantiate this. Land managers, county commissioners, and other local authorities need information on the location of avalanche paths and the frequency and intensity of avalanches to safeguard the public while permitting orderly growth of mountain communities and allowing for winter recreational opportunities.

Scientists at the Rocky Mountain Station, in cooperation with Montana State University, have developed computer models that simulate snow and avalanche characteristics and help in understanding the hows and whys of avalanche activity.



These computer models are described in three new papers. The first, *Numerical Simulation of Snow Avalanche Flow,* Research Paper RM-205-FR19, by T. E. Lang, K. L. Dawson, and M. Martinelli, Jr., presents a new technique for estimating the runout distance and debris depths for specific avalanche paths based on terrain and snow conditions. This technique should prove useful in developing avalanche zoning maps.

The second paper, *Numerical Simulation of Jet Roof Geometry for Snow Cornice Control,* Research Paper RM-206-FR19, is authorized by K. L. Dawson and T. E. Lang. In many areas, snow cornices and the snow cushion that often forms downslope from them present serious safety problems. Snow avalanches triggered by falling cornice blocks or by failure in the snow cushion are common on such slopes. Strategic placement of a simple wind deflector, called a jet roof, at the ridge crest will often alleviate the problem by deflecting the wind down the lee slope and preventing or reducing the formation of the cornice and changing the snow deposition pattern on the slope. This paper gives information regarding the location and shape of such structures, based on a computer program modeling of wind flow patterns over the ridge.

Dynamics of Snow Avalanche Impact on Structures, by T. E. Land and R. L. Brown, is the third in the series. Research Paper RM-207-FR19 summarizes new methodology for predicting the pressure and force distributions on rigid structures subjected to avalanche impact.

For copies of the first two avalanche papers, write to the Rocky Mountain Station. The third publication will be available later this summer.

Planning for prescribed burning

Those who want to know more about the effects of fire and how to use fire in managing forests and rangeland may get help from a new report, *Planning for Prescribed Burning in the Inland Northwest,* General Technical Report PNW-76, by Robert E. Martin and John D. Dell—available from the Pacific Northwest Station. The guide is designed for use in eastern Oregon and Washington, but general principles may be more widely applicable.

The guidelines provide information on the basic effects of wildfire and prescribed fire on forest and range ecosystems and on possible uses for prescribed fire—everything from fire hazard reduction and silviculture, to insect and disease control, wildlife habitat management, range management, or to improve esthetics, recreation, and access for man and animals. In addition, the guidelines give practical information for planning and carrying out prescribed burns and for evaluating such burns.

*U.S. GOVERNMENT PRINTING OFFICE: 1979 — 680-218/491

It is an entertaining as well as informative summary, full of all kinds of interesting and useful information—and the authors are not necessarily unbiased about the benefits of fire. "A forest managed with fire," they claim, "is often much more pleasing to look at, provides more opportunities for recreation, and allows better access. Frequent, low-intensity wildfires generally kept the ponderosa pine forests of the region open and parklike, where early pioneers could 'let their horses take their heads.' In contrast, many of these same forests today are choked with shrubs or stagnated thickets of reproduction because of fire exclusion. Reintroduction of fire can reduce the shrubs and thickets, recreate park-like vistas, provide more space for recreation, and create access for man and animals."

Beetle management proceedings published

The National Science Foundation, Washington State University, University of Idaho, and USDA Forest Service sponsored the Theory and Practice of Mountain Pine Beetle Management in Lodgepole Pine Forests Symposium in Pullman, Washington, April 25-27, 1978. The objective was to present information that would be useful in developing integrated pest management strategies for the mountain pine beetle, *Dendroctonus ponderosae* Hopkins.

The symposium evolved from a cooperative research project, an integrated pest management program involving the Forest Service, the University of Idaho, and Washington State University.

Papers presented at the Symposium dealt with management problems, causes of the problems, integration and analysis, solutions to the problems, and new information and approaches. The agenda included a rather unique section—land managers were asked to evaluate the Symposium and the research efforts it represented. Their comments are included in the published Proceedings.

The 26 papers presented have been published in *Theory and Practice of Mountain Pine Beetle Management in Lodgepole Pine Forests.* Copies, at $10.00 each, are available from: Editorial Department, Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho 83843.

Symposium planned

The Intermountain Station and the University of Montana will sponsor a Symposium on "Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests" in Missoula, Montana, September 11-13, 1979. The Symposium is intended to present the results of research conducted by Forest Residues Utilization Research and Development Program researchers and cooperators in the central and northern Rocky Mountain area.

For further information, write to the Center for Continuing Education, University of Montana, 107 Main Hall,, Missoula, Montana 59812, telephone (406) 243-2900.

You'll find good reading in the October issue. We'll provide an update on the SEAM (Surface Environment and Mining) Program; look at studies on genetic tree improvement; and review new research publications, along with other interesting features.

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